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AIR FLOW RESISTANCE OF POLYAMIDE 12 MADE BY SELECTIVE LASER SINTERING

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ABSTRACT

This paper presents the measurements of the air flow resistance of polyamide 12 samples made by selective laser sintering. The results have shown that, due to the porosity of the microstructure, the samples with thickness smaller than 1.7 mm cannot be considered airtight, while the samples with thickness 2.2 mm are airtight. The airflow resistance of the samples that allow airflow increases with air speed.

Keywords: *air flow resistance, porosity*, *additive manufacturing, polyamide*.

INTRODUCTION

Selective laser sintering (SLS) is one of the most popular additive manufacturing (AM) technologies because of the superior mechanical properties of the produced parts in comparison with other AM technologies. The basic material used for production of plastic parts by SLS is polyamide 12 (PA 12). However, the measurements have shown that the densities of parts produced by SLS are around 10% smaller than the densities of the parts made by injection moulding. Microscopic analyses revealed that the parts produced by SLS have grainy structure and contain porosities. According to the specifications of the manufacturer of the PA12 powder with trade name PA2200, the parts produced from that material by SLS with thicknesses under 1.5 mm, due to the porosity, are not watertight. Since the SLS are used for production of various pneumatic components, as well as to other components which are exposed to air flow and air pressure, the influence of the porosity of the polyamide 12 to the air flow and air pressure is of practical interest.

METHODOLOGY

Air resistance is one of the main parameters that describe the behaviour of the porous materials exposed to air flow (Wittstock, Schmelzer 2018). The air resistance (measured in Pa·s/m^3) is defined as a quotient of pressure difference on two sides of an obstacle to air flow (measured in Pa) and the volumetric airflow through the obstacle (measured in m^3/s). This paper presents the measurements of air flow resistance of 40 samples made from PA 2200 using the SLS technology. All the samples had shape of disk with diameter of 100 mm and were divided into four sets with different thicknesses, 0.7 mm, 1.2 mm, 1.7 mm and 2.2 mm. Each set consisted of 10 samples. The air flow resistance of the samples was measured according to ISO 9053 standard using steady state air flow method. The volumetric airflow varied between 12.5 mm/s and 36 mm/s.

RESULTS AND CONCLUSIONS

The air flow resistance of the samples with thickness of 2.2 mm was too high to be measured by the described methodology, which means that the samples with the thicknesses higher than 2.2 mm may be considered airtight.

The results of the measurements of the airflow resistance for the samples with thicknesses smaller than 1.7 mm are presented in the Figure 1. Each data point in the diagram represents a mean value of the airflow resistance of the set of 10 samples with the same thickness. While each of the samples under the study allowed airflow, it may be noted that the samples with thickness 1.7 mm showed substantial increase of the airflow resistance with increase of the air speed. Since this may be of interest for the applications with high-frequency dynamics (e.g. sound absorption and audio technics), further frequency analysis of the obtained results will be made.

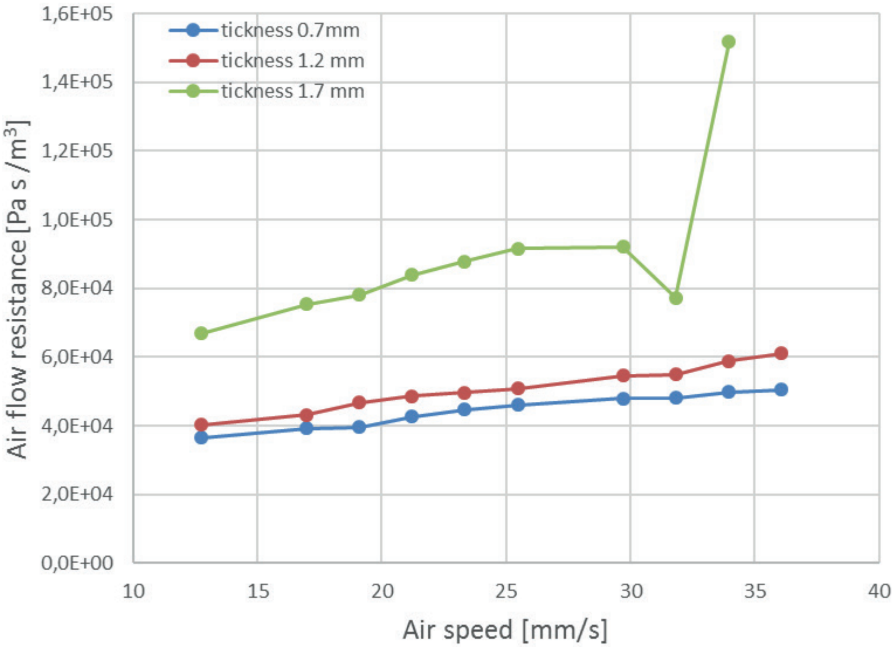

Fig. 1 – Air flow resistance

The presented results lead to the conclusion that the limiting thickness to consider the products made from polyamide 12 by SLS to be airtight is between 1.7 mm and 2.2 mm, and is certainly higher than the limiting thickness to consider the products to be watertight.

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